CLAIMS

We claim:

1. A hybrid cemented carbide composite, comprising:

a cemented carbide dispersed phase; and

a cemented carbide continuous phase, wherein the contiguity ratio of the dispersed phase is less than or equal to 0.48.

2. The hybrid cemented carbide composite of claim 1, wherein the contiguity ratio of dispersed phase is less than 0.4.

3. The hybrid cemented carbide composite of claim 2, wherein the contiguity ratio of the dispersed phase is less than 0.2.

4. The hybrid cemented carbide composite of claim 1, wherein the hardness of the dispersed phase is greater than the hardness of the continuous phase.

5. The hybrid cemented carbide composite of claim 1, further comprising:

a second cement carbide dispersed phase, wherein at least one of the composition and the properties of the second cemented carbide dispersed phase is different than the other cemented carbide dispersed phase.

6. The hybrid cemented carbide composite of claim 1, wherein the dispersed phase is between about 2 and about 50 percent by volume of the composite material

7. The hybrid cemented carbide composite of claim 6, wherein the dispersed phase is between 2 and 25 percent by volume of the composite material.

8. The hybrid cemented carbide composite of claim 1, wherein the hardness of the dispersed phase is greater than or equal to 88 HRA and less than or equal to 95 HRA.

9. The hybrid cemented carbide composite of claim 8, wherein the Palmquist Toughness of the continuous phase is greater than 10 Mpa.m$^{1/2}$.

10. The hybrid cemented carbide composite of claim 8, wherein the hardness of the continuous phase is greater than or equal to 78 and less than or equal to 91 HRA.

11. The hybrid cemented carbide of claim 1, wherein the cemented carbides of the dispersed phase and the cemented carbides of the continuous phase independently comprise at least one of carbides of at least one transition metal selected from titanium, chromium, vanadium, zirconium, hafnium, tantalum, molybdenum, niobium, and tungsten and a binder comprising cobalt, nickel, iron, and alloys of cobalt, nickel, and iron.

12. The hybrid cemented carbide of claim 11, wherein the binder further comprises an alloying agent selected from tungsten, titanium, tantalum, niobium, chromium, molybdenum, boron, carbon, silicon, and ruthenium.

13. The hybrid cemented carbide composite of claim 11, wherein the cemented carbide dispersed phase comprises tungsten carbide and cobalt and the cemented carbide continuous phase comprises tungsten carbide and cobalt.

14. The hybrid cemented carbide composite of claim 12, wherein the binder concentration of the dispersed phase is between about 2 wt% and about 15 wt% and the binder concentration of the continuous phase is between about 6 wt% and 30 wt%.

15. A hybrid cemented carbide composite, comprising:

a first cemented carbide dispersed phase wherein a volume fraction of the dispersed phase is less than 50 volume percent; and

a second cemented carbide continuous phase,

wherein the dispersed phase has a contiguity ratio less than or equal to 1.5 times the volume fraction of the dispersed phase in the composite.

16. The hybrid cemented carbide composite of claim 15, wherein the first cemented carbide and the second cemented carbide independently comprise at least one of carbides of at least one transition metal selected from titanium, chromium, vanadium, zirconium, hafnium, tantalum, molybdenum, niobium, and tungsten and a binder comprising cobalt, nickel, iron, and alloys of cobalt, nickel, and iron.

17. The hybrid cemented carbide composite of claim 16, wherein the binder further comprises an alloying agent selected from tungsten, titanium, tantalum, niobium, chromium, molybdenum, boron, carbon, silicon, and ruthenium.

18. The hybrid cemented carbide composite of claim 15, having a wear resistance greater than 0.7 $10/mm^3$ and a palmquist toughness greater than 10 $Mpa.m^{1/2}$.

19. The hybrid cemented carbide composite of claim 18, having a palmquist toughness greater than 20 $Mpa.m^{1/2}$.

20. The hybrid cemented carbide composite of claim 15, wherein the dispersed phase has a contiguity ratio of less than or equal to 0.48.

21. The hybrid cemented carbide composite of claim 20, wherein the contiguity ratio of the dispersed phase is greater than 0 and less than or equal to 0.4.

22. The hybrid cemented carbide composite of claim 21, wherein the contiguity ratio of the first phase is greater than 0 to about 0.3.

23. A method of making a hybrid cemented carbide composite, comprising:

blending at least one of partially and fully sintered granules of a first dispersed cemented carbide grade with at least one of green and unsintered granules of a second continuous cemented carbide grade;

consolidating the blend to form a compact; and

sintering the compact to form a hybrid cemented carbide.

24. The method of claim 23, wherein the blend comprises about 2 to less than 40 volume percent sintered granules and greater than 60 to about 98 volume percent unsintered cemented carbide granules.

25. The method of claim 24, further comprising heating a metal powder comprising a metal carbide and a binder to form the sintered granules.

26. The method of claim 25, wherein sintering the metal powder is performed at a temperature between 400°C and 1300°C.

27. The method of claim 24, wherein the blend comprises between about 2 and about 30 vol.% percent sintered granules and between about 70 and about 98 vol.% unsintered granules.

28. The method of claim 23, wherein the first dispersed cemented carbide grade and the second continuous cemented carbide grade independently comprise at least one of carbides of at least one transition metal selected from titanium, chromium, vanadium, zirconium, hafnium, tantalum, molybdenum, niobium, and tungsten and a binder comprising cobalt, nickel, iron, and alloys of cobalt, nickel, and iron.

29. The method of claim 28, wherein the binder further comprises an alloying agent selected from tungsten, titanium, tantalum, niobium, chromium, molybdenum, boron, carbon, silicon, and ruthenium.